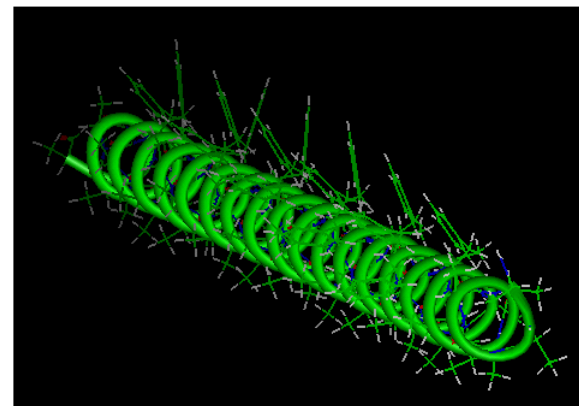


# Proteins Containing Non-natural Amino Acids as Building Blocks for Novel Materials

Kristi L. Kiick, University of Delaware, DMR-0239744

Protein and peptides offer many opportunities for the production of advanced materials for nanotechnology applications, as their structure can be exactly controlled and manipulated. The inclusion of novel chemically reactive functional groups in proteins will further expand their potential utility in device applications, but this research area is currently largely unexplored. The aim of this DMR project is to design and synthesize protein polymers that are decorated with non-natural amino acids, and to further elaborate these scaffolds to produce hybrid electroactive molecules with potential use in light emitting devices. A schematic of the highly helical structure of the peptides and proteins is shown on the right and the helical structure has been verified experimentally. We have also demonstrated that the inclusion of certain non-natural amino acids into molecules such as these has significant impact on the types and stability of the conformations that the molecules adopt, and that the non-natural amino acids can be modified toward the synthesis of well-controlled advanced materials. Demonstrating the utility of these molecules in light-emitting layers of devices is an ultimate goal of this work, and may have application in the production of luminescent displays.



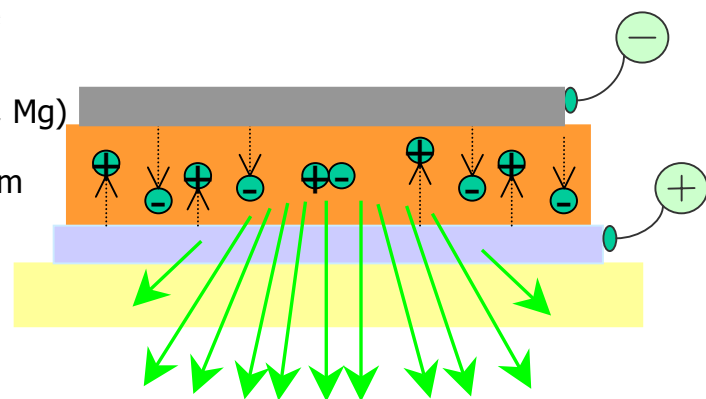
Schematic of the helical molecules under investigation in this work

Metal Cathode (Au, Al, Si, Mg)

Light-emitting polymer film

ITO (Indium tin oxide)

Glass substrate



The novel proteins and polymers produced in this work may serve as light-emitting polymers in devices such as the one shown above.

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## Education:

This National Science Foundation funded project has stimulated collaboration between biosynthetic and organic synthetic groups at the University of Delaware, and has fostered a highly interdisciplinary learning environment, encompassing both biosynthetic methods and electroactive polymer design, for the two graduate students currently involved in this project. Additionally, the Kiick laboratories have hosted several undergraduate research students in the laboratories during the summer and semesters, and these students have gained exposure to the use of artificial proteins in materials applications. A graduate course on the use of biopolymers in materials applications was also developed by Kiick during 2003.

## Outreach:

Outreach at the secondary school level has involved two types of activities. First, three high school students have been active in conducting

research in the Kiick laboratories, from DNA synthesis to block copolymer synthesis. Secondly, the inaugural module for an outreach program, “The Science of Art”, was implemented in early 2004. The students in the Arts and Crafts curriculum at Haddon Township High School (NJ) were introduced, by Prof. Kiick, to the materials concepts involved in ceramic glaze formulation. The students blended the various components of a majolica glaze to produce their own glaze compositions, which they used in their sculpture projects to create desired visual and tactile effects. The outreach program stimulated both creative and scientific thought, and expansion of the program to other materials is underway.



Glaze formulation in class and discussion of glaze properties.